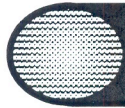


What is a dwarf planet?

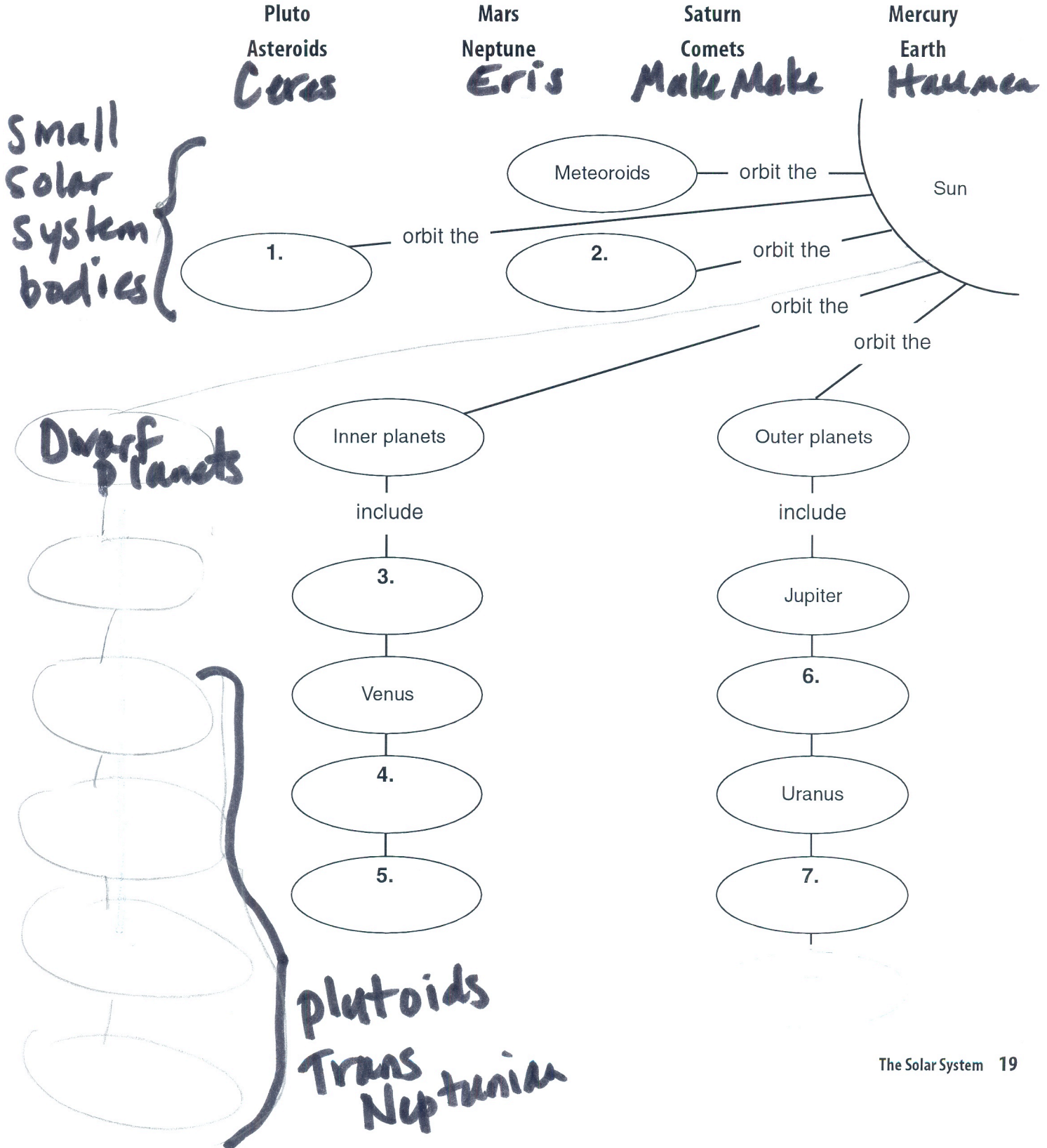
1. What decision was made by the IAU on August 24, 2006?
2. What are the 3 rules that define an object as a planet?
3. What are the rules that define a dwarf planet?
4. What is a plutoid? Which dwarf planets are plutoids? Which is not?
5. What are the names of the four identified dwarf planets?
6. Give three facts about Eris.
7. List three facts about Pluto.
8. List three facts about Ceres.
9. Name the fourth dwarf planet as of September 2008. List two facts.
10. Name the fifth dwarf planet and list two facts.



Directed Reading for
Content Mastery

Overview
The Solar System

Directions: Complete the concept map using the terms in the list below.





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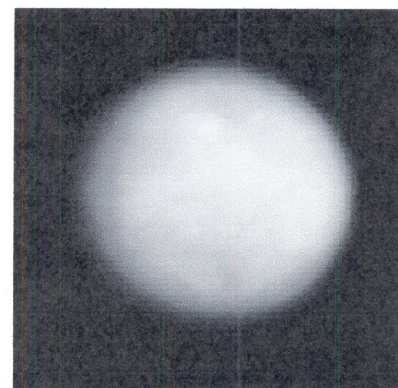
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Dwarf Planets:

What Defines a Planet, Dwarf Planet or Plutoid?

What constitutes a planet? The [International Astronomical Union \(IAU\)](#) developed some definitions in 2001, modified them again in 2003, and as of August 24, 2006, the IAU has come up with another definition. The IAU said in a statement that the definition for a planet is now officially known as "a celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape and (c) has cleared the neighborhood around its orbit."



Ceres' round shape suggests that its interior is layered like those of terrestrial planets such as Earth.

Dwarf Planets

A "dwarf planet" is a celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, (c) has not cleared the neighborhood around its orbit, and (d) is not a satellite.

Plutoids

Almost two years after the International Astronomical Union (IAU) General Assembly introduced the category of dwarf planets, the IAU, as promised, has decided on a name for trans-neptunian dwarf planets similar to Pluto. The name "plutoid" was proposed by the members of the IAU Committee on Small Body Nomenclature (CSBN), accepted by the Board of Division III, by the IAU Working Group for Planetary System Nomenclature (WGPSN) and approved by the IAU Executive Committee at its recent meeting in Oslo, Norway.

Plutoids are celestial bodies in orbit around the Sun at a semi-major axis greater than that of Neptune that have sufficient mass for their self-gravity to overcome rigid body forces so that they assume a hydrostatic equilibrium (near-spherical) shape, and that have not cleared the neighborhood around their orbit. Satellites of plutoids are not plutoids themselves, even if they are massive enough that their shape is dictated by self-gravity. The three known and named plutoids are Pluto, Eris and as of July 2008, MakeMake. It is expected that more plutoids will be named as science progresses and new discoveries are made.

While all plutoids are dwarf planets, it is interesting to note that not all dwarf planets are plutoids, as is the case with Ceres.

(and) formally downgraded Pluto from an official planet to a dwarf planet. According to the new rules a planet meets three criteria: it must orbit the Sun, it must be big enough for gravity to squash it into a round ball, and it must have cleared other things out of the way in its orbital neighborhood. The latter measure knocks out Pluto and 2003UB313 (Eris), which orbit among the icy wrecks of the Kuiper Belt, and Ceres, which is in the asteroid belt. In 2008, Pluto, Eris and most recently, MakeMake have been classified as "plutoids," while presently there are no plans to reclassify Ceres. Discovered by American astronomer Clyde Tombaugh in 1930, Pluto takes 248 years to orbit the Sun. Pluto's most recent close approach to the Sun was in 1989. Between 1979 and 1999, Pluto's highly elliptical orbit brought it closer to the Sun than Neptune, providing rare opportunities to study this small, cold, distant world and its companion moon, Charon. Most of what we know about Pluto we have learned since the late 1970s from Earth-based observations, the Infrared Astronomical Satellite (IRAS), and the Hubble Space Telescope. Many of the key questions about Pluto, Charon, and the outer fringes of our solar system await close-up observations by a robotic space flight mission. No spacecraft have yet visited Pluto. However, NASA launched a mission called New Horizons that is en route to this icy world and will explore both Pluto and the Kuiper Belt region. All other objects except satellites orbiting the sun shall be referred to collectively as "Small Solar-System Bodies." According to the IAU, more dwarf planets as well as plutoids are expected to be announced in the coming months and years. For example, in July, 2008, a new plutoid dwarf planet has been officially named by the IAU. The name Makemake has been approved for the Transneptunian Dwarf Planet (136472) 2005 FY9. Makemake is named after a creator god of Rapa Nui (Easter Island). Currently, more than a dozen candidate dwarf planets are listed on IAU's dwarf planet watch list, which keeps changing as new objects are found and the physics of the existing candidates becomes better-known.

According to Paul Hertz, Chief Scientist for the Science Mission Directorate at NASA Headquarters, NASA will use the new guidelines established by the International Astronomical Union, and continue pursuing exploration of the most scientifically interesting objects in the solar system, regardless of how they are categorized.

Acknowledged Dwarf Planets (Three Of Which Are "Plutoids")

A dwarf planet is a category of celestial bodies defined in a resolution passed by the International Astronomical Union (IAU) on August 24, 2006.

Currently, there are four celestial bodies that have been redefined by the IAU as dwarf planets, and three of which has been reclassified as a subset known as plutoids:

- UB313 (also known as a plutoid, informally known as Xena, and now formally known as Eris)
- Pluto (also known as a plutoid)
- Ceres (remains in the category of dwarf planet)
- MakeMake (also known as a plutoid, new official name for Dwarf Planet 136472 2005 FY9)

UB313 or Eris

In July 2005, Astronomer Mike Brown of CalTech and his team announced the discovery of yet another Kuiper Belt Object - this one larger than Pluto. This object, provisionally named UB313, or Xena, has officially been named Eris by the IAU.

The new dwarf planet was defined as such by the IAU on August 24, 2006. In 2008, the IAU has once again reclassified Eris as a subset known as a plutoid-- promoting a deeper understanding of the celestial bodies in our solar system. Eris has a diameter of 3,000 km (1,850 miles) which is 700 km (435 miles) larger than Pluto. These new observations were made using a sensitive sensor on the IRAM 30-m telescope that measured the heat emitted by the new object, and found it had a

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similar reflectivity to Pluto. This allowed them to calculate its size.

Eris is significant because it is now known as the largest dwarf planet and more distinctly, a plutoid, in the solar system. It is the largest object found in orbit around the sun since the discovery of Neptune and its moon Triton in 1846.

Eris is the most distant object ever seen in orbit around the sun, even more distant than Sedna, the Kuiper Belt object discovered in 2003. It is almost 10 billion miles from the sun and more than 3 times more distant than the next closest plutoid, Pluto, and takes more than twice as long to orbit the sun as Pluto.

Pluto

Once known as the smallest, coldest, and most distant planet from the Sun, Pluto has a dual identity, not to mention being enshrouded in controversy since its discovery in 1930. Pluto is also a member of a group of objects that orbit in a disc-like zone beyond the orbit of Neptune called the Kuiper Belt. This distant region consists of thousands of miniature icy worlds with diameters of at least 1,000 km and is also believed to be the source of some comets.

Pluto has three known moons, Hydra and Nix, besides its companion moon, Charon. At about 1,186 km (737 miles), Charon's diameter is a little more than half of Pluto's.

Pluto and Charon orbit the Sun in a region where there may be a population of hundreds or thousands of similar bodies that were formed early in solar system history. These objects are referred to interchangeably as trans-Neptunian objects, Edgeworth-Kuiper Disk objects or ice dwarves. Pluto is about two-thirds the diameter of Earth's Moon and may have a rocky core surrounded by a mantle of water ice. Due to its lower density, its mass is about one-sixth that of the Moon. Pluto appears to have a bright layer of frozen methane, nitrogen, and carbon monoxide on its surface. While it is close to the Sun, these ices thaw, rise, and temporarily form a thin atmosphere, with a pressure one one-millionth that of Earth's atmosphere. Pluto's low gravity (about 6 percent of Earth's) causes the atmosphere to be much more extended in altitude than our planet's. Because Pluto's orbit is so elliptical, Pluto grows much colder during the part of each orbit when it is traveling away from the Sun. During this time, the bulk of the planet's atmosphere freezes. In 1978, American astronomers James Christy and Robert Harrington discovered that Pluto has a satellite (moon), which they named Charon. Charon is almost half the size of Pluto and shares the same orbit. Pluto and Charon are thus essentially a double planet. Charon's surface is covered with dirty water ice and doesn't reflect as much light as Pluto's surface. Because Pluto is so small and far away, it is difficult to observe from Earth. In the late 1980s, Pluto and Charon passed in front of each other repeatedly for several years. Observations of these rare events allowed astronomers to make crude maps of each body. From these maps it was learned that Pluto has polar caps, as well as large, dark spots nearer its equator. The duo's gravity has locked them into a mutually synchronous orbit, which keeps each one facing the other with the same side. Many moons - including our own - keep the same hemisphere facing their planet. But this is the only case in which the planet always presents the same hemisphere to its moon. If you stood on one and watched the other, it would appear to hover in place, never moving across the sky.

Charon was discovered in 1978, while two additional moons Hydra and Nix, were discovered in 2005.

In Greek mythology, Charon was the boatman who carried the souls of the dead to the underworld - a kingdom that in Roman mythology was ruled by the god, Pluto. The U.S. Naval Observatory's James Christy suggested the name after he found the moon in 1978.

Seven years later, Charon and Pluto began a five-year period of eclipsing each other from Earth's point of view. That was lucky for us, because it enabled scientists to measure the diameters and masses of both objects as each passed in front of the other.

HAUMEA

Oddly-shaped Haumea is one of the fastest rotating large objects in our solar system. It completes a turn on its axis every four hours. The quick spin elongated the dwarf planet into the unique shape astronomers discovered in 2003. It is roughly the same size as Pluto. Like Pluto and Eris, Haumea orbits our Sun in the Kuiper Belt, a distant zone of icy objects beyond the orbit of Neptune. It takes 285 Earth years for Haumea to make one orbit around our sun.

It is possible a massive impact billions of years ago set off Haumea's spin and created its moons. Haumea's known moons are Hi'aka and Namaka. Astronomers believe Haumea is made of rock with a coating of ice.

Discovery:

Haumea was discovered in March 2003 at the Sierra Nevada Observatory in Spain. The official announcement of its discovery came in 2005, the same year its moons were discovered.

How Haumea got its name:

Originally designated 2003 EL61 (and nicknamed Santa by its discoverers), Haumea is named for the Hawaiian goddess of childbirth and fertility. Its moons are named for daughters of Haumea. Hi'aka is the patron goddess of the island of Hawaii and of hula dancers. Namaka is a water spirit in Hawaiian mythology.

Charon appears to be covered by water ice, which differs from Pluto's surface of frozen nitrogen, methane, and carbon dioxide. One theory is that the materials that formed Charon were blasted out of Pluto in a collision. That's very similar to the way in which our own moon is thought to have been created.

NASA launched its [New Horizons](#) spacecraft to Pluto and Charon in January 2006, and it should arrive in 2015, becoming the first spacecraft to visit them. In preparation, the New Horizons project is organizing a search for additional moons of Pluto, using ground-based telescopes and possibly the [Hubble Space Telescope](#).

Ceres

Ceres has been classified as a dwarf planet that might also be classified as an asteroid. While there are three known dwarf planets, there are only two that have been classified further as plutoids. Ceres remains in the dwarf planet category because of its position in the asteroid belt between Mars and Jupiter. Its name is derived from the Roman goddess Ceres. Discovered on January 1, 1801, by Giuseppe Piazzi, Ceres has a diameter of about 950 kilometers and is by far the largest and most massive known body in the asteroid belt, as it contains approximately a third of the belt's total mass.

The classification of Ceres has changed several times. Even though it was classified as a planet when it was first discovered, because it resembled similar bodies in the asteroid belt it was reclassified as an asteroid for over 150 years, and now retains its name as a dwarf planet.

As the first such body to be discovered, its name was prefixed by the number 1, under the modern system of asteroid numbering. After the discovery of the trans-Neptunian object 2003 UB313 (Eris), a proposition was made by the International Astronomical Union to reinstate Ceres to the status of planet along with Pluto's moon, Charon, and Eris.

Instead, on August 24, 2006, an alternate proposal came into effect labeling Ceres a 'dwarf planet'. It is not yet clear whether dwarf planet status is, like planet status, a sole defining category, or whether dwarf planets also retain their previous minor body classifications such as "asteroid."

(136472) 2005 FY9 or now called MakeMake

The name Makemake has been approved for the plutoid transneptunian dwarf planet (136472) 2005 FY9. Makemake is a creator god of Rapa Nui (Easter Island). Discovered on March 31, 2005 by Michael Brown and his team at the Palomar Observatory, MakeMake is the third largest known dwarf planet in the Solar System and about a third of the diameter of Pluto. Initially known as 2005 FY9 (and later given the number 136472), its discovery was announced on July 29, 2005. On June 11, 2008, the IAU included Makemake in its list of potential candidates to be given "plutoid" status, a term for dwarf planets beyond the orbit of Neptune that would place the object alongside Pluto and Eris. Makemake was formally classified as a plutoid in July 2008.

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